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Plants

By Formula

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Built-In Resistance

Crops with built-in resistance to insects and diseases offer an ideal way to reduce or eliminate pesticide residues.

In the next few years, ARS will place added emphasis on breeding resistance into crops as well as on finding more specific and less persistent pesticides; developing biological nonchemical, and sterility methods of insect control: and learning more about the fate and effects of pesticide residues.

Many new biological control methods are appearing on the horizon, including pathogens that kill only specific insect pests (p. 3, this issue) and a lady beetle that is a natural enemy of the surgarcane mealybug (p. 11, this issue).

But plants that are resistant to pests, would offer a most promising long-term solution to the residue problem. A commercial variety of sweetclover that is resistant to the weevil, for example, would eliminate spraying to control this pest (p. 10, this issue). It would also expand the use of sweetclover as a forage and soil-improvement crop.

Resistance to diseases has gone even farther. Geneticists have developed sugar beets that resist curly top, potatoes that resist late blight and leafroll, lettuce that resists downy mildew, peaches that resist bacterial spot, and white pines that resist blister rust—to mention a few.

New pests and new strains of old diseases continue, however, to threaten agriculture. Plant breeders succeeded in developing, over many months, lima beans that were resistant to downy mildew. But the very year the new beans were released, another strain of the disease appeared, and plant breeders began anew developing a variety with resistance to both strains (AGR. RES., June 1964, p. 15).

This is why resistant plants cannot be the entire answer to pest control—and why scientists continue to study and improve on other methods.

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Gaining Momentum:

A MICROBIAL WAR ON INSECTS

Pathologists study a seemingly endless source of biological control

■ The great number and diversity of forms of insect pathogens—and the safety with which they can be used—present enormous possibilities for the development of biological control of insects.

Insect pathologists already can cite the successful use of these microbial organisms against at least 16 insect species in actual control operations or in extensive field tests.

But more than 1,000 pathogens—including viruses, bacteria, fungi, protozoa, rickettsia, and nematodes—are known to infect and kill insects. And the pathologists believe that these are only a small fraction of the total.

Some of these microbial agents are specific, infecting only one insect species; others act across a broad spectrum, infecting many species. But even more vital to the research pathologist—most of the insect pathogens do not harm man and other animals.

Pathogens have been used successfully against such insects as the Japanese beetle (AGR. RES., August 1963, p. 3), the introduced European spruce sawfly, the European pine sawfly, the Virginia pine sawfly, the great basin tent caterpillar, the Swain jackpine sawfly, the pine processionary moth, the alfalfa caterpillar, the cabbage looper (AGR. RES., December 1963, p. 3), the bollworm (also called corn earworm), the gypsy moth, the nun moth, the linden looper, the red banded leafroller, the fall webworm, and the tobacco budworm.

Less than an eyedropper of virus material (top) is needed to treat 10 acres. This virus, a nuclear polyhedral type, infects and kills cabbage loopers. The virus particles (bottom) are embedded in a many-sided (polyhedral) protein body, illustrated by cross-sectional plaster model.

Although most of the tests with these insects have been carried out by public and private organizations in the United States, many research contributions have been made by institutions in other countries.

ARS research in insect pathology is strategically located throughout the United States to give scientists an opportunity to experiment with the widest possible range of economically important insects.

At Beltsville, Md., nine scientists in the Insect Pathology Pioneering Research Laboratory concentrate on the mode of action of pathogens—how they kill insects. Related studies include taxonomy and nutrition of the micro-organisms and their hosts.

The reasoning behind these pioneering studies: If pathologists understand how the pathogen acts, by what means it acts, and what aids or resists this action, they will then be in an ideal position to make full use of the micro-organism as a control agent in the field.

Other ARS insect pathologists are

WAR ON INSECTS
(Continued)

studying numerous problems specific to the areas covered by regional laboratories. These include grasshoppers, Bozeman, Mont.; corn earworm and fall army worm, Tifton, Ga.; European corn borer, Ankeny, Iowa; Japanese beetle, European cockchafer, Moorestown, N.J.; citrus red mite and cabbage looper, Riverside, Calif.; citrus rust mite, Orlando, Fla.; coddling moth, Kearneysville, W. Va.; vegetable insects, Charleston, S.C.; flue-cured tobacco insects, Florence, S.C.; boll weevil, State College, Miss.; mosquitoes, Lake Charles, La., and Gainesville, Fla.; cattle insects, horseflies, and ticks, Kerrville, Tex.; and bollworm, pink bollworm, and cabbage looper, Brownsville, Tex.

Research on bee diseases, differing from that of most insect pathology studies, is designed not to cause diseases but to prevent them. Beltsville serves as headquarters for this research, supported by laboratories at Laramie, Wyo., and Baton Rouge, La.

Many of the studies at regional laboratories are made in cooperation with State agricultural experiment stations or other State agencies.

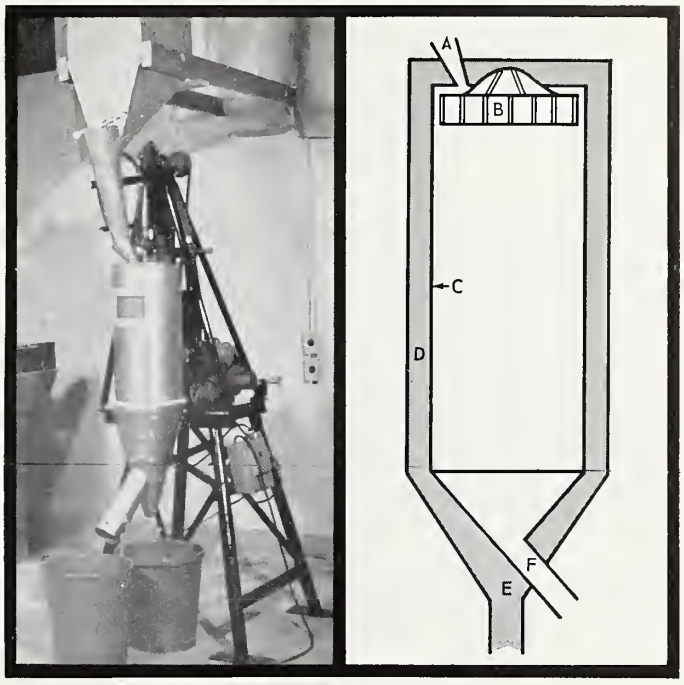
A constant alert for insect diseases is maintained abroad by ARS entomologists whose primary job is searching for insect parasites and predators. When these scientists find a promising disease, they send cultures or diseased insects to the Pioneering Laboratory at Beltsville for study.

Twenty salt-marsh caterpillars were placed on each kale plant (above) and in each flat of bean plants (below). The healthy kale plant was treated with bacterium (Bacillus thuringiensis) *and the healthy bean plants with a bacterium-virus combination* (B. thuringiensis and granulosis *virus*). *The insect-damaged plants received no treatment.*

In addition to its own investigative work in this country and abroad, ARS maintains contacts with most of the world's insect pathology laboratories for the exchange of pathogen cultures and reference material. ARS also obtains new knowledge in studies of natural insect enemies (including diseases) being conducted in India, Israel, Italy, Pakistan, Poland, and Spain through grants under Public Law 480.

Insect pathologists and other entomologists believe that pathogens, either used alone or integrated with other control methods, will eventually play an important role in insect control. They are reluctant to make firm predictions—but not from a lack of confidence. They know that any prediction made on the basis of present knowledge is almost certain to be conservative in the light of new knowledge a few years hence.☆

Seed and trash enter (A) and are fed into rotating ribbed disc (B), which sprays material onto the inside of the rotating screen (C), where it is held by centrifugal force. A shaking action (7/16 inch, 1,200 times a minute) moves the crop down the inside surface of the screen. Seeds aline with holes and pass through the screen to outer shell (D) through (E) to a hopper. Larger particles (trash and weed seeds) move down the screen and out the bottom (F). Screen size is varied to meet seed size requirements.



Separating Seed

VERTICALLY

■ Experimental equipment now being tested in Oregon may be the forerunner of better machines for cleaning and separating seed.

The test equipment has performed convincingly in cleaning seed to remove both trash and weed seeds that came through the combine.

The main feature of the cleaner-separator—which operates on the principle of centrifugal force—is a cylindrical screen that is mounted vertically in the experimental unit and provides both a rotating and a shaking action.

ARS agricultural engineers J. E. Harmond and J. K. Park developed the equipment in cooperative research with the Oregon Agricultural Experiment Station. The engineers feel that the principle used in their equipment can be applied to develop commercial machines that do the same jobs as those presently available but that will operate at higher capacities and with increased efficiency.

In present machines, materials to be separated are spread on flat screens that shake back and forth. The seed falls by gravity through the screen and the trash stays on top.

Drawbacks of flat screen

But this conventional method has several disadvantages:

- It is not efficient with light, small seeds, which tend to "float" in the trash rather than settle to the screen.
- Capacity is limited by the size of the screen and force of gravity; that is, the only way to increase capacity effectively is to increase the size of the screen. This is not always practical.
- The flat screens have to be level. If a combine, for example, is operating on a hillside. the seed and trash material will "walk" to the downhill side of the screen.
- A brush travels across the underside of the flat screen to keep trash from lodging in the screen openings. This has proved to be an inefficient and complicated mechanism.

Benefits of cylindrical screen

The equipment developed by Harmond and Park overcomes these disadvantages and offers some other advantages as well:

1. The new screen takes less space because it is cylindrical.
2. The capacity of the vertical screen can be increased by increasing the speed of rotation. Centrifugal force can be increased as much as 10 times the force of gravity with little or no damage to most seeds.
3. Centrifugal force holds material against the screen, so the machine should operate as effectively on a slope as on level ground.
4. Since centrifugal force keeps the material in constant contact with the screen, seeds cannot float no matter how light they are.
5. Cleaning the screen during operation is no problem. One rotary brush can be mounted in the housing so that it is in constant contact with the turning screen. ☆

Seeding Abandoned Cropland

Scientists test methods best suited to Central Great Plains

■ Grass seeding practices developed by ARS and Colorado Agricultural Experiment Station scientists may help Central Great Plains ranchers establish crested wheatgrass and Russian wildrye on extensive acreages of abandoned croplands.

The research was conducted on abandoned cropland at the Central Plains Experiment Range near Nunn, Colo., by ARS range conservationists R. E. Bement and L. O. Hylton, Jr. They worked cooperatively with Colorado agricultural engineer R. E. Barmington, range conservationist A. C. Everson, and statistician E. E. Remmenga.

Preparing seedbed is necessary

The scientists found that seedbed preparation is necessary to obtain satisfactory stands of either crested wheatgrass or Russian wildrye in the area, where the average annual rainfall is 10 to 15 inches.

Crested wheatgrass developed satisfactory stands when planted either in the spring or late summer, in contrast to Russian wildrye which developed good stands only when planted in late summer. Many Russian wildrye seedlings from spring plantings did not survive the summer.

Plots seeded in late summer had been cleared of cover growth in the spring and cultivated that summer to control weeds. Allowing the land to lie fallow like this during the summer before seeding made more moisture available for the seedlings.

Plots seeded in the spring had been cultivated the previous summer or tilled just before planting.

Both crested wheatgrass and Russian wildrye were also seeded in the fall on land that was prepared only by removing a narrow band of native vegetation with a lister or sweep blade. The seed was drilled directly behind the blades. Grasses planted in plots prepared in this manner, however, did not establish satisfactory stands.

Companion crop is unsuccessful

Companion crops did not help the grass become established; the low rainfall rate in the Colorado experimental range area is not sufficient to support both a companion crop and range grasses.

The scientists confined seedbeds to strips 33 feet wide, leaving existing vegetation in alternate strips for protection against wind erosion. Row spacing, varying from 7 to 28 inches, did not affect stand establishment, but those plants that were grown in the more widely spaced rows grew bigger.

Packing the seedbeds only once

The researchers obtained the most satisfactory seeding results with this drill, equipped with double-disk furrow openers and depth band regulators. Seeding was made on fallowed land.

Formerly abandoned cropland now supports good stand of crested wheatgrass. Alternating strips were seeded to protect against wind erosion.

after seeding was satisfactory. Other tests have shown that packing more than once on the sandy soil has little effect on the number of seedlings established.

Drill places seed at 1 inch

A special drill developed at the Colorado station was the most satisfactory machine used in planting. The drill was equipped with double-disk furrow openers having depth band regulators and with packer wheels to firm the soil after planting. This drill placed the seed at a uniform depth of 1 inch.

Two warm-season grasses native to the arid Western plains, blue grama and side-oats grama, were not successfully established in these trials largely because of the lack of available moisture during the time of the trials. Grama seed germinate only after the ground becomes warm and receives adequate summer moisture. Scientists have not yet found an economical method of seeding the gramas in areas as dry as Nunn, Colo., where natural establishment is difficult.

Crested wheatgrass and Russian wildrye start their growth in the spring, utilizing stored winter moisture. These grasses, where established, provide green feed in the spring while the grama grasses are still dormant.☆

Better Preweaning Records for...

Crossbred Calves

■ Crossbred calves had better preweaning records than straightbreds in the first of a three-phase ARS-Nebraska experiment designed to evaluate crossbred vigor (heterosis) in beef cattle. The crossbred calves excelled in birth weight, average daily gain, weaning weight at 200 days, and weaning conformation score.

ARS and Nebraska Agricultural Experiment Station scientists are using Angus, Hereford, and Shorthorn breeds in their studies of heterosis at the Fort Robinson Beef Cattle Research Station.

Bulls of each breed are mated to cows of their own breed as well as to cows of the other two breeds to produce straightbreds and all possible crosses. The effects of heterosis are measured by comparing the average traits of the crossbreds with the average traits of the straightbreds.

The scientists are evaluating preweaning and postweaning growth rate, livability of calves, feed efficiency, and carcass traits in the first phase of the experiment. Straightbred and crossbred heifers born in the first phase are then kept for the second phase in which scientists measure the effects of heterosis on fertility and mothering ability. In the third phase, scientists will evaluate procedures to determine which system of crossbreeding would be most effective for commercial producers.

Cows used in the first phase—80 of each breed—produced calf crops each year, 1960 through 1963. In setting up the experiment, the researchers made a deliberate attempt to obtain stock of each breed from several sources. Cows were purchased as calves in 1957 from commercial producers in Nebraska, Montana, and Colorado. Bulls came from breeders' herds and experiment station herds in nine North Central and Western States.

Besides exceeding straightbreds in all preweaning growth traits studied, crossbred calves had better livability, particularly the first few days after birth, and they reached puberty at younger ages. In comparing the crosses, the scientists found that increased vigor was greater in the Hereford-Angus and Hereford-Shorthorn crosses than in the Angus-Shorthorn cross.

Preliminary results of postweaning traits—from the 1960, 1961, and 1962 calf crops—indicate that crossbreds exceed straightbreds in growth rate. They also have a slight advantage in feed efficiency.

Crossbreds appear to be slightly fatter than the straightbreds, but there has been no difference in carcass grades. Crossbred carcasses yielded more pounds of edible meat, but the percentage of boneless trimmed retail cuts from the round, loin, rib, and chuck was slightly lower than in the straightbred carcasses.☆

Blending Light and Chemicals to grow...

PLANTS BY FORM

■ As architects plan a home to fit the owner's needs, ARS plant scientists are "designing" many ornamental plants to meet the desires of today's homeowners.

Instead of brick, mortar, and lumber, they use plants, soil, and nutrients. They manipulate these materials by treating with growth-regulating chemicals and by controlling light, temperature. and humidity.

In research at Beltsville, Md., scientists are showing how two of these manipulators—light and growth-regulating chemicals—can be put to work in plant "construction."

Light indirectly controls many plant-growth processes through its effect on phytochrome, a light-sensitive pigment. Phytochrome, discovered in 1952 by H. A. Borthwick and S. B. Hendricks of ARS, changes form and directs certain plant developments in response to the kind and amount of light it receives. Through light control, then. the ARS scientists regulate phytochrome, which in turn controls many plant-growth processes.

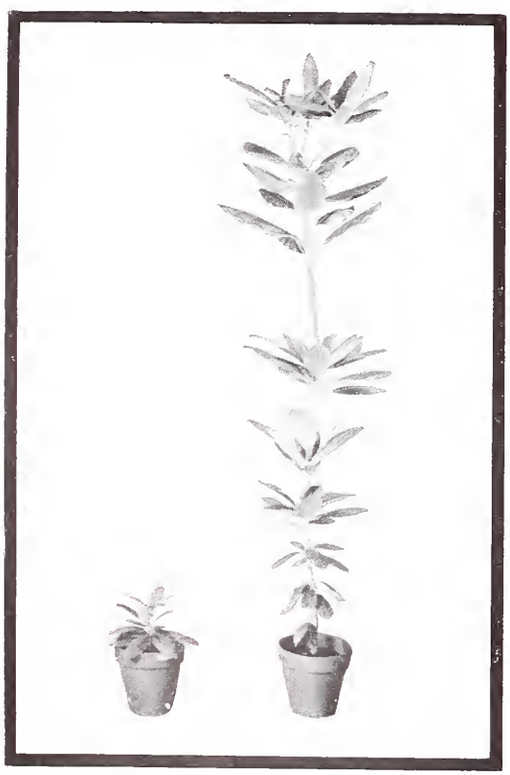
By applying light and chemicals according to specifications, the Beltsville scientists can control size, flowering, and shape of a great many ornamental and other plants. What is more, the methods they use are such that commercial growers or home gardeners may duplicate the treatments and achieve predictable results every time.

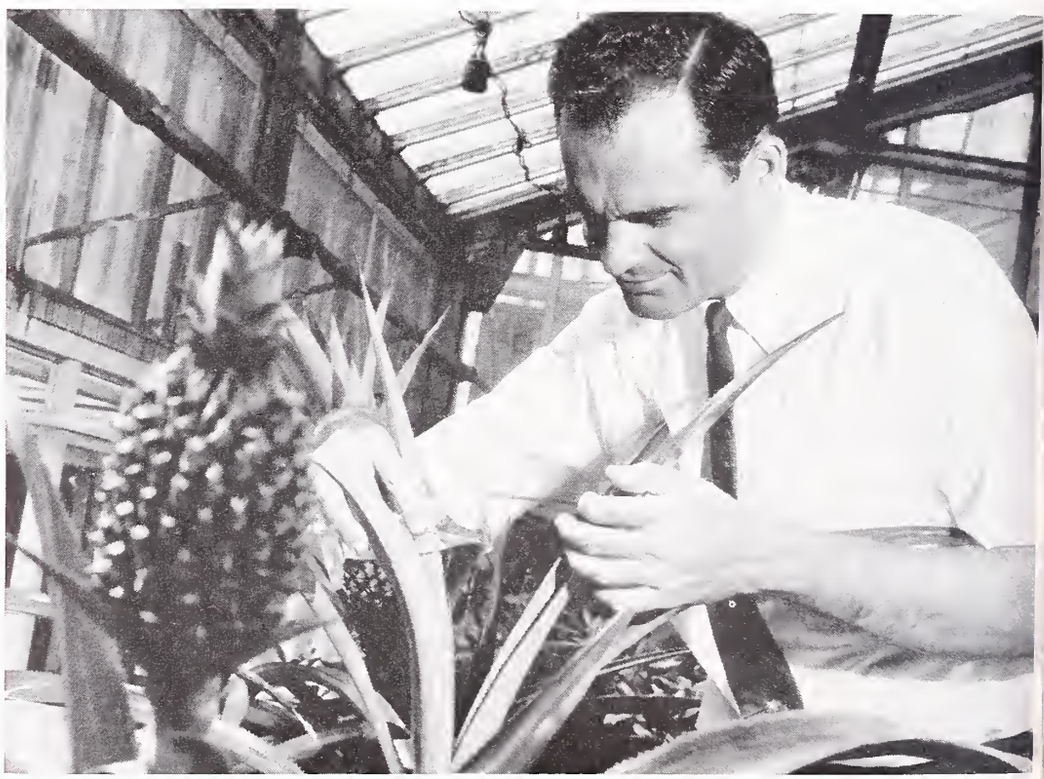
A few of the ornamental plants now under control are illustrated here.

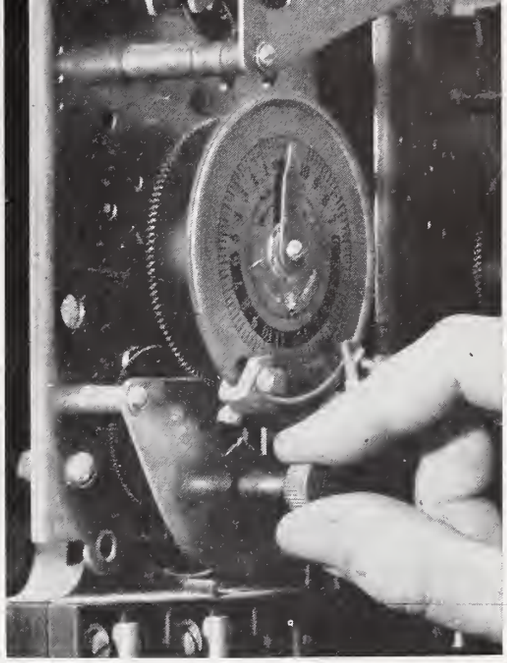
Shorter and sturdier marigolds

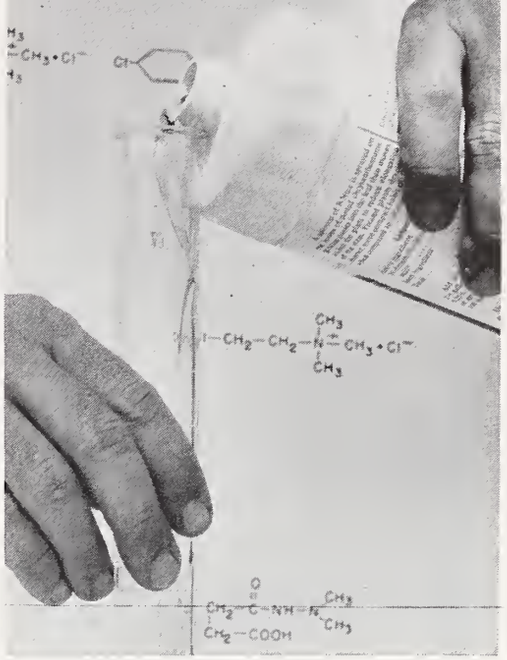
The American marigold is generally a gangly 4-footer that needs staking Through the judicious application o

LEFT—Here's what light alone can do: Beltsville scientists grew the rhododendron on the left on only 8 hours of light a day. The other received natural daylight plus 4 hours a night of incandescent light until it reached its present size. RIGHT—H. M. Cathey fills the crown of a 2-year-old pineapple plant with a 1,000-p.p.m. solution of hydrazine. He will allow it to remain in the crown for 24 hours. As a result, the plant will flower and will frui in about 6 months, as the plant in the foreground has done. Usually, pineapple plants don't fruit for 3 or 4 years.









Timing and Proportion—the watchwords in plant control:
Setting the timers, which will switch on the incandescent lighting at Beltsville greenhouses . . . And measuring the chemical solution that will help regulate growth and flowering in plants.

he chemical N-dimethylamino succi-
amic acid, however, it can be trans-
ormed into a sturdy and attractive
arden plant half that height. It can
lso become an even shorter, year-
ound potted house plant when sub-
ected to both controlled lighting and
hemical treatment. And since it re-
quires only a 2-month growing pe-
iod from seed to sale, the trans-
ormed marigold is expected to be-
ome a popular florist item.

Another chemical, B-hydroxyethyl hydrazine, can do wonders for ornamental plants of the pineapple family, which, as a houseplant, normally doesn't flower or fruit at all. A single application of the chemical—poured in the cuplike crown formed by the leaves surrounding the stem tip and left there for 24 hours—will produce flowers and fruit in 1 to 6 months, depending on the species. As a result, ornamental plants of the pineapple family can be made more decorative—and they can be timed to bloom and fruit for any occasion.

These marigolds were all grown on long days and all are about 12 weeks old. The plant on the left was treated with a growth retardant and all growth stopped. The center plant was treated with a chemical that retards growth but does not stop it, as indicated by the development of flowers. The plant on the right was not treated chemically.

Rhododendrons flower at 1 year

Year-old rhododendron plants have also been made to flower with the proper combination of light and growth regulator. Rhododendrons normally do not flower until they are considerably older. With the controls now possible, rhododendron shows promise of becoming commercially popular among homeowners as a flowering house plant.

N. W. Stuart and H. M. Cathey, who work on light and chemical control of ornamentals at Beltsville, stress that the two vital elements in regulating plants in this manner are timing and proportion—the right amount of light of proper duration, and the right proportion of chemical administered at proper intervals.☆

Wild species offers source of resistance to costly insect pest

Sweetclover that Resists the Weevil

■ A wild sweetclover species may have a source of resistance to the sweetclover weevil that scientists can transfer to commercial sweetclovers.

ARS scientists found in tests that adult weevils did not feed upon the leaves of the wild species *Melilotus infesta* but fed heavily upon all other species of sweetclover.

Entomologist G. R. Manglitz and plant geneticist H. J. Gorz conducted the tests in cooperation with the Nebraska Agricultural Experiment Station. Their finding is the first indication of resistance to the weevil in sweetclover.

The scientists are working to transfer this resistance to commercially important sweetclover varieties. *M. infesta* is not acceptable as a forage, hay, or soil-improvement crop.

Development of a weevil-resistant sweetclover that is commercially acceptable would enhance this plant's potential as a forage and soil improvement crop. The sweetclover weevil has discouraged many farmers from trying to grow the crop, which partially explains the widespread decline of sweetclover acreages in the Northern Great Plains and other areas.

Conquering the weevil by genetic changes in the sweetclover plant would also greatly reduce dependence upon insecticides.

Scientists do not know why the weevil, *Sitona cylindricollis* Fahraeus, does not eat the leaves of *M. infesta*. Research has shown no indication that the wild sweetclover species is harmful to the pest.

Although weevils confined to *M. infesta* produced fewer eggs, they apparently did so because of starvation. Surviving weevils recovered their egg-laying ability about as well as weevils kept without food, when both groups were later fed the same diet.☆

Sweetclover weevil inflicted heavy damage (top photo) to a commercial variety of sweetclover (Melilotus officinalis) *in experimental plots at Lincoln, Nebr. However, in adjacent weevil-infested plots (bottom photo), the insect did not attack the wild sweetclover species* (Melilotus infesta).

TOP—Beneficial lady beetles (Hyperaspis trilineata) *feed on costly sugarcane mealybug* (Trionymus sacchari).

BOTTOM—Larvae of H. trilineata *also feed on the mealybug, as well as on mealybug larvae and eggs.*

For Hawaiian sugarcane growers . . .

A Friendly Lady Beetle

■ Hawaiian sugarcane growers hope a beetle, newly introduced to their islands, will thrive and multiply. It is a natural enemy of the sugarcane mealybug, a damaging pest of the Hawaiian sugarcane crop.

The beneficial insect, a small lady beetle, *Hyperaspis trilineata*, was imported from Barbados, British West Indies. It has preyed on the sugarcane mealybug, *Trionymus sacchari*, so successfully in Barbados that it is difficult to find the two insects in the same area, and damage to sugarcane there has largely been eliminated.

With the help of the Barbados Ministry of Agriculture, ARS entomologist L. W. Coles collected about 4,000 of the predators in Barbados and shipped them to Hawaii via the ARS quarantine station in Moorestown, N.J. Entomologists from the Hawaiian Sugar Planters' Association—which first suggested the introduction—have released several colonies of the lady beetles in the State.

Scientists say it's still too early to tell whether the lady beetle has been successfully established in Hawaii. In the laboratory, however, the lady beetles have shown themselves entirely capable of reproducing on mealybug-infested pieces of sugarcane. They have also thrived in the laboratory on the gray sugarcane mealybug, *Pseudococcus boninsis*, a common pest of the Florida canefields.

The lady beetles apparently have a taste for *T. sacchari* through most of their life cycle. Adult beetles and larvae attack adult mealybugs and mealybug larvae. Beetle larvae often seek mealybug larvae and eggs from under the mother mealybug. Like the mealybugs, the lady beetles prefer the space under the tight leaves or sheaths of the cane plant as a habitat, where they inflict maximum damage to the mealybugs.

If the beetle becomes established in Hawaii it may end most damage from sugarcane mealybugs there as it has in Barbados. The introduction of the beetle into Hawaii is one of numerous ARS studies now underway to control insect pests by biological means.☆

HEATED TURF

Buried cable keeps grass growing in winter on athletic fields

■ Electric heating may be used some day to improve the turf on sports fields in the United States. At least research by ARS and Purdue Agricultural Experiment Station scientists shows that the method has possibilities.

ARS agricultural engineer J. R. Barrett, Jr., and Purdue turf specialist W. H. Daniel have kept sections of a Purdue University practice football field green and growing during the winter months by placing electric heating cables below the soil surface.

This use of heating cables is not new. Research on turf heating has been done in England and Sweden, and a few fields are heated in these countries. The research at Purdue is apparently the first investigation of its kind in the United States.

Heat from the buried cables keeps the soil from freezing, helps melt the snow, and stimulates both root and blade growth in the grass.

In one Purdue test, freshly cut sod was laid on heated and unheated plots in early November. By the end of December, roots 3 to 5 inches long had developed in the heated turf. And by April, roots in the heated turf were 9 inches long; in the unheated turf, they were only 5 inches long.

Heated turf produced seedheads 6 weeks earlier the following spring than unheated turf, indicating the grass had continued to grow during the winter months.

Daniel points out that fast root development can be important in establishing turf when a baseball field is converted to a football field in the fall. The heat also helps establish the turf faster in the spring, important in getting a field ready for the baseball season.

Cables were buried 4, 6, and 8 inches deep. Although there were no apparent differences in soil or turf condition due to cable depth, Barrett suggests cables be placed at least 6 inches deep to reduce the possibility of mechanical damage to the cables.

Various cable spacings and types of heating cables have been used to provide heat inputs of 0.8 up to 10 watts per square foot of turf area.

One test plot was covered with clear plastic to hold in the heat and to take advantage of solar radiation. The scientists found that plastic kept the grass from drying out, reduced the amount of electricity needed for heating the turf, gave earlier and more uniform rooting of the turf, and provided faster growth in early spring. The covered turf remained greener than uncovered turf, even at air temperatures of −20° F.

Plastic has some disadvantages, however. The area cannot be used while it is covered. Hot sunny spells may force unwanted growth and cause the foliage to become tender and more suspectible to physical damage. And high humidity under the plastic may favor development of leafspot diseases.

The ARS and Purdue scientists plan more research to get data on cost and other information to determine the practical potential of turf heating.☆

Heated turf plots, established on Purdue University's practice football field, test varying amounts of wattage each, left to right: 2.5 watts per square foot on 24 hours; 4.5 watts, at night when electricity is cheaper and when air temperature drops below 45°; 9 watts (same basis as second plot); 9 watts on 24 hours a day; and 4.5 watts on 24 hours. Each plot is 10 by 120 feet, separated by 10 feet of unheated area.

Can Insects Develop Resistance to Chemosterilants?

Initial studies with yellow fever mosquito indicate that they can

■ Along with the promise of becoming valuable tools in the control of insect pests, chemicals that sterilize insects carry a built-in question: Can insects develop resistance to these chemosterilants as they have to certain chemical insecticides?

Two recent ARS laboratory experiments with yellow fever mosquitoes have provided the first evidence. The initial answer—at least for this one species—is that resistance to chemosterilants can be developed.

ARS scientists E. I. Hazard, C. S. Lofgren, D. B. Woodard, H. R. Ford, and B. M. Glancey conducted the experiments to determine whether the yellow fever mosquito, *Aedes aegypti*, can develop resistance to apholate, a widely tested chemosterilant.

The studies were made at Gainesville, Fla., in the ARS laboratory devoted to research on insects affecting man and animals.

Mosquitoes used in each test were divided into two groups—one to be treated with apholate and one to remain untreated as a check. Selection for resistance involved treating larvae in succeeding generations with a concentration of apholate low enough that not all mosquitoes would become sterile. These were allowed to reproduce as adults, and their larvae were treated in turn.

In the first experiment, larvae were treated with a solution of 5 p.p.m. of apholate in tap water. Sterility declined during the first four generations from 96 to 46 percent. In the fifth generation, the concentration of apholate was increased to 15 p.p.m. This dosage, calculated to cause complete sterility under ordinary conditions, caused only 72 percent sterility.

Treatment in the second experiment also started with a concentration of 5 p.p.m. Sterility dropped from 91 percent in the first generation to 77 percent in the fifth. Percentages ranged from 52 to 38 percent in the next three generations. The concentration of apholate was increased from 5 to 10 p.p.m. in treating the ninth generation, and 81-percent sterility resulted. By the 11th generation, however, sterility had gone down to 59 percent.

In both experiments, the researchers noted increased resistance to the sterilizing effect of apholate, even when the concentration of the chemosterilant was increased. Sterility rates in the untreated colonies, kept as a check, averaged 13.9 percent in the first experiment, 7.9 in the second.

In the second experiment, beginning with the seventh generation, mosquitoes from the previously untreated or unselected colony were given the same dosages of apholate as the treated or selected colony. This provided a direct comparison of sterility between the two colonies. The comparison showed that treatment of 5 p.p.m. caused sterility of 52 percent in the selected colony in the seventh generation and 84 percent in the same generation of the unselected colony. When the dosage was increased to 10 p.p.m., sterility in the selected colony started at 81 percent in the 9th generation and dropped to 59 percent in the 11th, while there was 100-percent sterility in the 9th generation of the unselected colony.

Although research in this area still has a long way to go, the scientists say that initial results indicate that the yellow fever mosquito can develop resistance to apholate. Since the mode of action of apholate is generally the same as for the other major chemosterilants now being tested, the resistance factor apparently is one that will have to be considered in developing, testing, and planning for possible use of chemosterilants against insects.☆

Pine Gum

Yields low-cost chemicals potentially important in rubber, plastics

■ Low-cost peroxides potentially important to the rubber and plastics industries can be made from pine gum, by a process developed by ARS scientists.

The new peroxides are made by chemically modifying the pine gum through a process known as photosensitized oxidation, which includes bubbling air—in the presence of strong light—through a solution of pine gum that contains a dye.

W. H. Schuller, R. V. Lawrence, and J. C. Minor, of the Naval Stores Laboratory, Olustee, Fla., developed the process as part of a broad effort to find new uses for agricultural products. The scientists believe the rubber industry will find the new peroxides easy to work with, since the industry is familiar with and has used other pine gum derivatives in rubber for a number of years.

The plastics industry is expected to find the peroxides valuable as curing or vulcanizing agents in products such as vinyl plastics and casting and laminating resins for plastic boats and construction panels. They also may find an application in converting polyethylene from a thermoplastic product that softens and melts with heat to a thermosetting product that forms a solid with heat.

Another attractive feature of the peroxides is their high molecular weight, which adds a safety feature. Many low-molecular-weight peroxides now in use release large amounts of gases during the curing operation. Consequently, they are fire and explosion hazards unless carefully controlled.

By simply heating the pine gum peroxides in an inert solvent, they are converted to diopoxy compounds, which are used by the plastics industry in manufacturing adhesives and casting and laminating resins.☆

New Bovine TB Test

Seeks undetected carriers that continue to infect the herd

■ ARS scientists are seeking a good supplemental test that will spot tuberculosis-carrying cattle that don't react to the standard skin test.

It is these undetected carriers that make finishing the TB eradication job in the United States so difficult.

A herd of cattle may contain only one undetected TB-infected animal, which can spread the disease to other members of the herd. These animals develop TB, react to the skin test, and are removed. Meanwhile, the undetected carrier may remain as a continuing source of infection in the herd.

Following extensive research to solve this problem, ARS veterinarians A. B. Larson and K. E. Kopecky at the National Animal Disease Laboratory, Ames, Iowa, developed what they call a "modified thermal test," in which a large quantity of tuberculin is injected into a cow's veins and her temperature measured. If she develops a rise in body temperature of at least 1.5° F., peaking no lower than 103.2° F., she should be considered a reactor.

Test is tried on 76 herds

The new test was tried out on 76 cows from herds believed to contain undetected carriers. The cows were first given the standard skin test and 47 reacted. They were then given the thermal test and 21 reacted—16 that had reacted to the standard test and 5 that had not.

All 76 cows were slaughtered and examined at federally inspected establishments, and 35 were found to have tuberculosis lesions. Of the 47 cattle reacting to the standard skin test, 30 showed evidence of tuberculosis on post mortem examination; 16 of these did not react to the thermal test. Five cattle that reacted to the thermal test but not to the skin test were found infected on post mortem examination.

Larson and Kopecky say these results show that the modified thermal test cannot replace the standard skin test but that it can be useful as a supplementary tool in detecting TB-carrier cattle. The scientists are continuing their studies to further improve the new test.☆

Drylot lambs have fewer worms

Research at Beltsville, Md., has pinpointed some advantages of raising lambs in drylot instead of on pastures in humid areas.

Flock-management studies proved that lambs raised in drylots are less likely to require treatment for control of internal parasites than lambs raised on pastures. This would partly offset the higher cost of drylot feeding.

The extra costs of raising lambs in drylots would also be offset by higher weaning weights of lambs and heavier fleeces on ewe lambs. In the Beltsville experiments, drylot lambs averaged 74.7 pounds at weaning, compared to 67 pounds for pasture-raised lambs. Replacement ewes from drylot yearlings produced about 25 percent heavier fleeces than those kept full time on pastures.

In addition to relative costs, birth dates also influence whether lambs for slaughter should be reared on drylot or pasture. Since most lambs reach market weight (about 95 pounds) when they are about 150 days old, those born in January or February are ready for market before parasites become a major problem.

Vets intercept miniature horses

They would have been pretty in Chicago's Lincoln Park zoo—the two miniature horses from Argentina, meant for a gift to the zoo. But they had a rare skin disease catching to humans. They had cutaneous streptothricosis.

So did the team of six miniature horses from Argentina, intended as a show team for a California wine company. So too did the single horse imported by a man intending to make a business of buying and selling the yard-high creatures.

The horses were kept quarantined in isolation until they could be shipped back to Argentina—all this during the month of May.

The disease was found on the two zoo-destined horses and on the single trade horse by ARS veterinarians at the Clifton, N.J., Quarantine Station as they rubbed their hands over the

These two miniature horses, intended for a zoo in Chicago, were intercepted and returned to Argentina.

animals searching for ticks. ARS inspectors in Miami, Fla., discovered the disease on the six horses intended for a show team.

Scientists at the National Animal Disease Laboratory, Ames, Iowa, confirmed the veterinarians' diagnosis by isolating the funguslike organism, *Dermatophilus Congolensis,* that causes cutaneous streptothricosis in horses, cattle, sheep, and man.

This rare skin disease—told by wartlike pimples that are filled with thin whitish-yellow fluid, causing the hair to mat—was first found in the United States in 1960 on a wild deer in New York. Since then it has been found on horses and cattle in Texas, New York, Iowa, and Kansas.

In each case, the diseased animals were kept in isolation until they died or recovered. Although several medications were tried, none was as effective as keeping the animals in dry stalls, which helped in some cases.

PL 480 study covers sausage curing

Research in Finland has shown that pure cultures of bacteria are necessary to produce certain desired changes in dry sausages during the ripening process. Dry sausages are products such as salami that do not require refrigeration.

Scientists at the University of Helsinki, working under a 4-year grant, have completed studies of strains of bacteria that processors can use in making sausages that look and taste better and that keep these advantages during storage. They studied the chemical changes that take place in dry sausage during ripening, concentrating on finding the influence that starting cultures of bacteria have in inducing various qualities desired in the end product.

The grant was awarded under Public Law 480, which authorizes the sale of U.S. surplus agricultural products abroad for payment in foreign currencies. These currencies cannot be converted into dollars for use in the United States, but part of them can be used to pay for foreign research benefiting U.S. agriculture.

To find the pure bacterial cultures that help bring about the desired changes in color, taste, smell, texture, and keeping qualities during ripening, the scientists experimented with 380 selected bacteria from an original group of 702 strains.

It may be necessary to use several different pure cultures with every batch of sausages processed. It is difficult, they say, to find a strain of bacteria that can induce more than one of the desired changes. Only 3 of the 380 bacteria tested by the University of Helsinki scientists brought about simultaneous changes in color, texture, flavor, and aroma.

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AGRISEARCH NOTES

Vacuum cleaner clears hives of bees

Beekeepers can use the exhaust from a vacuum cleaner—instead of chemicals—to clear bees out of hive supers when harvesting honey, ARS-Wisconsin studies show. (Hive supers are the detachable sections where the bees store honey.)

Agricultural engineers B. F. Detroy of ARS and G. P. Barrington of the Wisconsin Agricultural Experiment Station found that the airflow method not only clears the hive super as fast as chemicals do, but it has the special advantage of working efficiently at all temperatures. Some chemicals lose efficiency as the temperature drops.

Detroy says most any shop-type vacuum can be used. It should have at least a 1.5-horsepower motor that delivers 65 cubic feet of air per minute at a pressure of 2 pounds. An air compressor will do the job, but it is not as portable as a vacuum cleaner.

A portable generator, which many farmers already have, is needed if bee colonies are located away from electricity.

The engineers direct the airflow with the standard crevice attachment that comes with the vacuum. The attachment, a long, flat tube with a narrow opening at one end, works very well but cleans only one inner space of the super at a time. Detroy and Barrington are designing a multiple nozzle device to clean out more than one inner space of the super at a time.

A shop-type vacuum cleaner and portable generator unit, carried in the back of a station wagon, are used to clear bees out of hives when harvesting honey.

Barley protects burned watershed

Barley planted in contour rows has proved the best first-aid treatment for reducing flood and erosion damage on burned watersheds.

The Forest Service came to this conclusion after more than 3 years of experiments in the San Dimas Experimental Forest, which is maintained in cooperation with California. The study was begun in 1960, after wildfire had destroyed 15,000 acres.

The methods tested were broadcast seeding of annual and perennial grasses, large contour trenches, small channel stabilization dams, and contour row plantings of barley. Twenty small watersheds (2 to 8 acres each) made up the study areas.

In the experiments, perennial grasses were the least effective in reducing peak runoff flows and erosion debris yields.

Annual grasses had little effect on moderating peaks but resulted in a 16-percent reduction in debris.

Channel stabilization structures had less effect in reducing peak flows than other physical treatments but accounted for about a 35-percent reduction in debris yields.

Because of steep topography, contour trenches could not be spaced closely enough to provide storage for runoff from large storms, but they reduced debris 60 percent.

Contour row plantings of barley were the most successful treatment for reducing both peak flows and debris yields, reducing debris 65 percent.

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